Tinkering 101: 3D printing

Using the TTU Makerspace's 3D Printers for spiffy designs

2020

Uses of Maker Technology

- Health and recovery
  - Prosthetics
    - https://www.youtube.com/watch?v=Cl8ijPGEKO8
    - https://www.youtube.com/watch?v=XQ8tPOqN7WE
- Design
  - Art!
    - http://www.joshharker.com/art/
- Construction
  - 3D –Printed houses
    - https://www.youtube.com/watch?v=GUdnrtnjT5Q
  - 3D-Printed Boats!
    - https://www.youtube.com/watch?v=Pt2epukih2k

https://tinyurl.com/3dgirlarm

Source: Ryan Cassidy presentation "Getting Started with 3D Printing"

Sean W Scully

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Makerspace Specialist – TTU Libraries Makerspace

Rhino3D, TinkerCAD, AutoCAD Inventor, Fusion360, NetFabb, Blender, Solidworks, ArtCAM Jewelsmith

MFA, Studio Art (Metals/Jewelry/Enameling), Kent State U, 2010

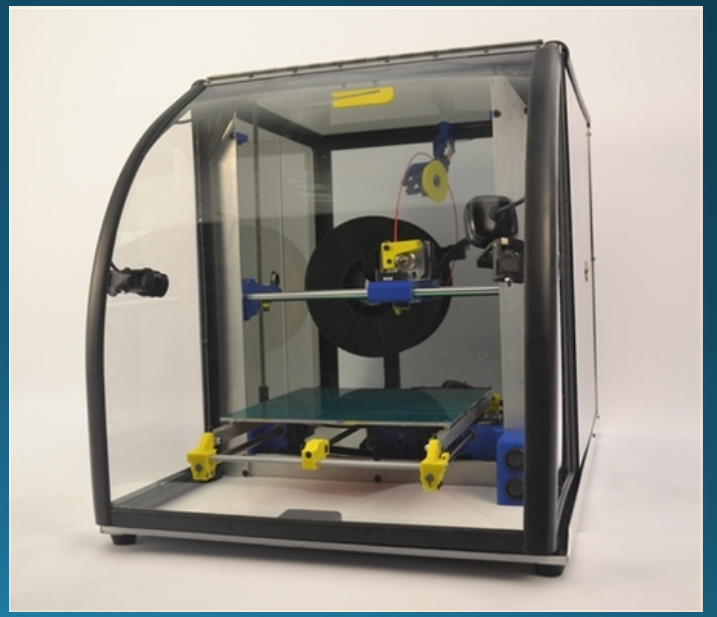
BFA, Studio Art (Metalsmithing/Jewelry Design), TTU, 2007

AA, Fine Arts, South Plains College, 2004

MAKER SPACE

RYAN CASSIDY | SEAN SCULLY

https://www.depts.ttu.edu/library/make/



- Cricut Maker
- Glowforge Lasercutter
- Matter&Form 3D Scanner
- PolyPrinters 229 & 508
- Ultimaker 3

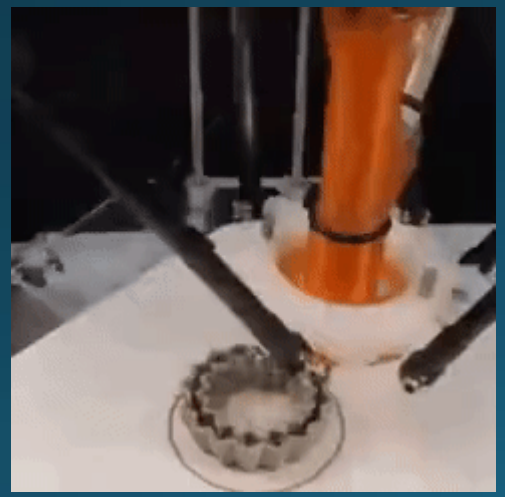
A Brief Introduction to Additive Manufacturing

And using the Texas Tech Library Makerspace 3D Printers

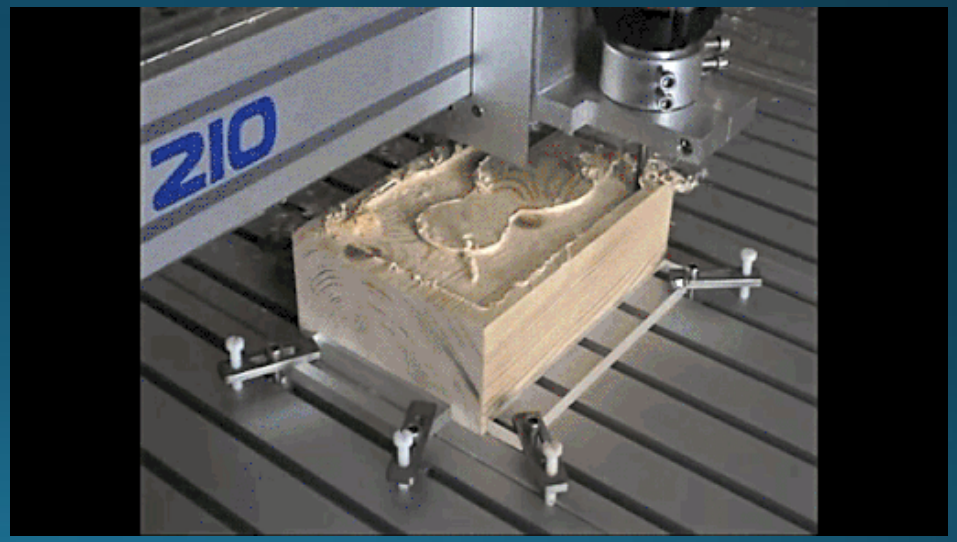
What 3D Printing is:

- **3D Printing**: adding layers of material to produce a model
- **CNC (Computer Numerical Control) Milling:** where material is reduced or carved away to produce a model

3D Printing vs. CNC Milling



https://tinyurl.com/3dprint-CLAY



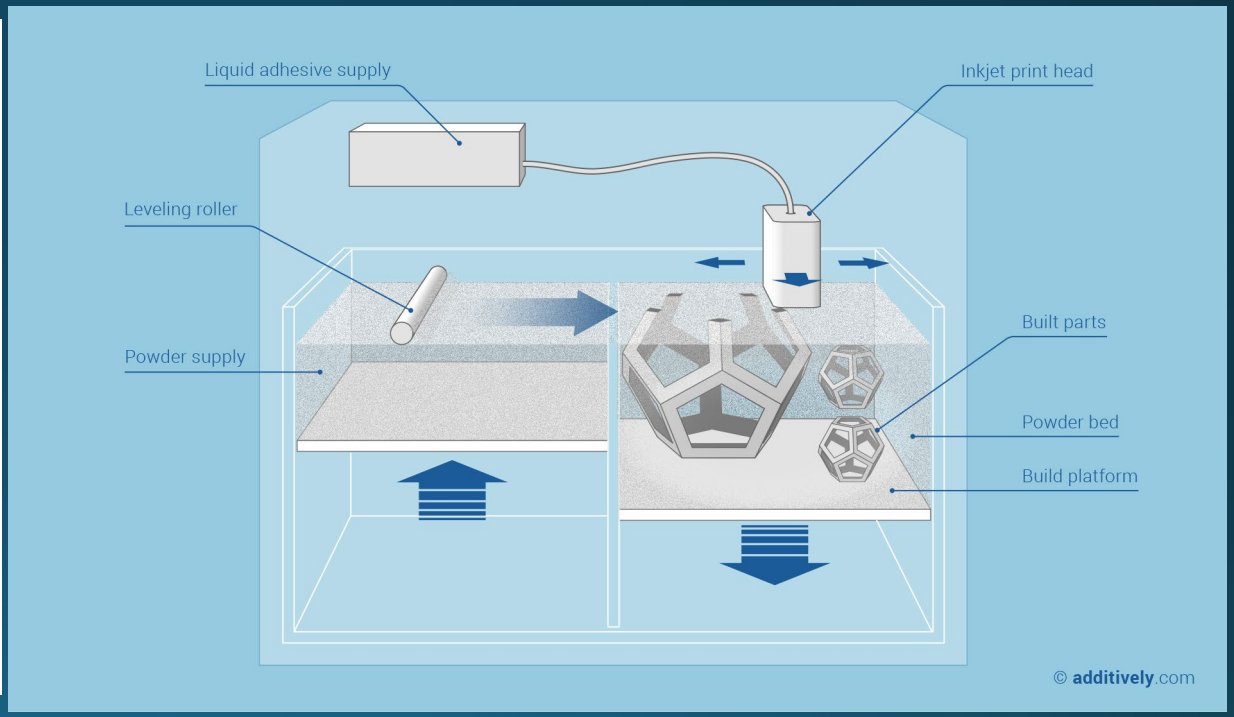
https://tinyurl.com/yyrtrau9

Three Common Styles of 3D Printer:

- Powder –layers of 'cornstarch' with a colored ink binder
  - ZCorp.
- Resin – Light-sensitive resin that hardens in layers as you expose it to images from a projector or a laser beam
  - Form1
- Filament – Fused-Deposition-Modeling (FDM) using a stream of material that hardens/cools that will fuse in layers
  - FFF-style printers (FFF - Fused Filament Fabrication)

Popular 3D Printer Types: Powder

Colored Binder

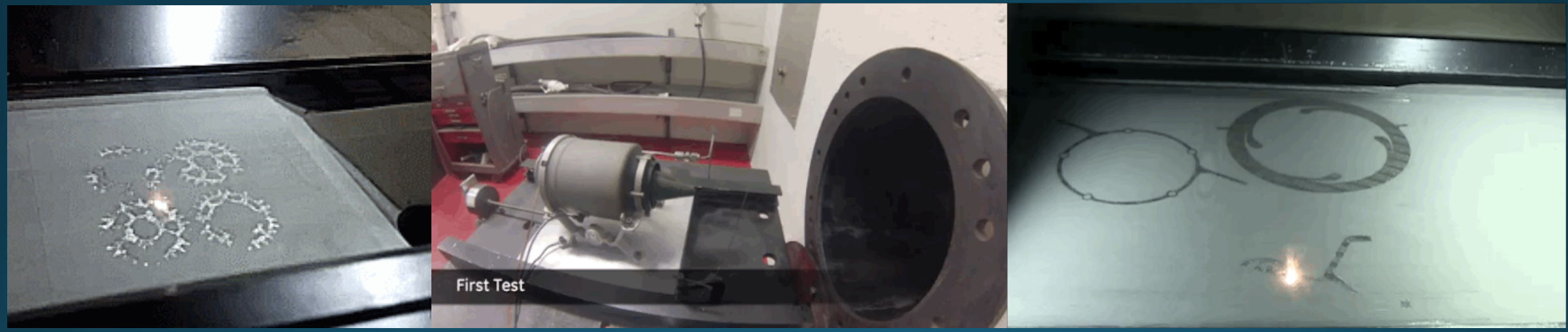


https://tinyurl.com/zcorpprocess

https://additively.com

Popular 3D Printer Types: Powder 2

Laser-sintered



https://tinyurl.com/metalpowderprint

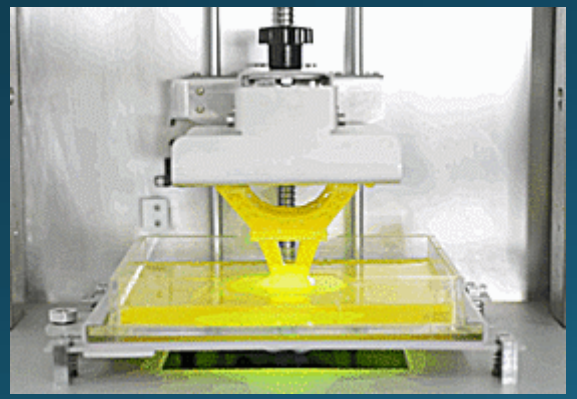
https://www.youtube.com/watch?v=yiUUZxp7bLQ

https://www.ge.com/reports/post/118394013625/these-engineers-3d-printed-a-mini-jet-engine-then/

Popular 3D Printer Types: Resin

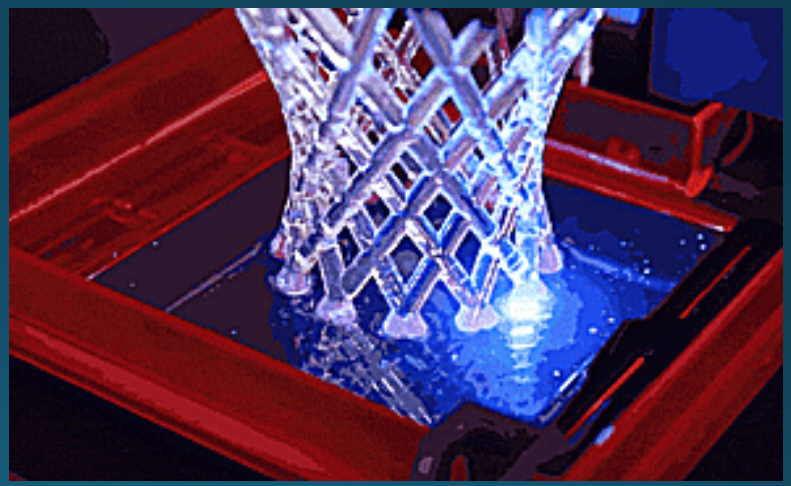
Projector

https://tinyurl.com/formlab



https://tinyurl.com/makexprinter

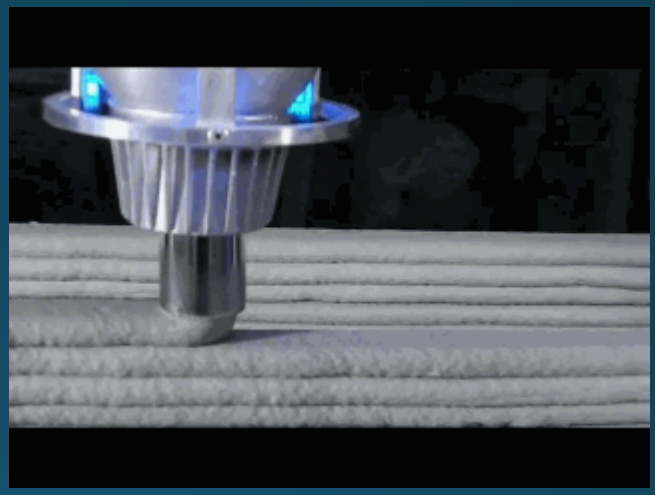
Laser



https://tinyurl.com/formlabprinter2

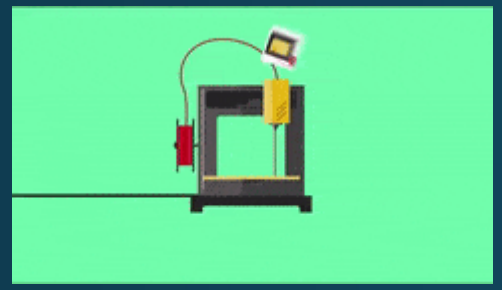
Popular 3D Printer Types: Filament

https://tinyurl.com/3dprinthouses



youtube.com/watch?v=2eNp6q35uRo

Popular 3D Printer Types: Filament 2



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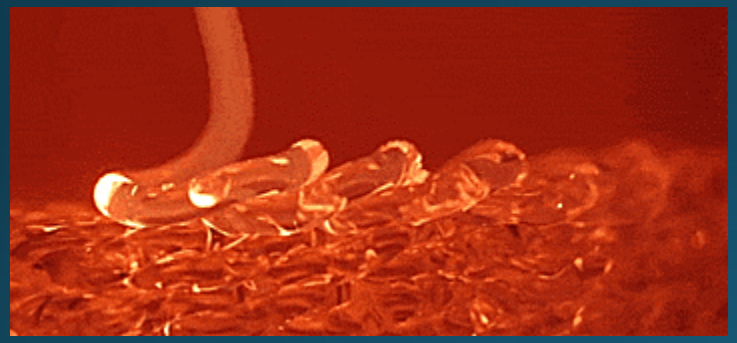
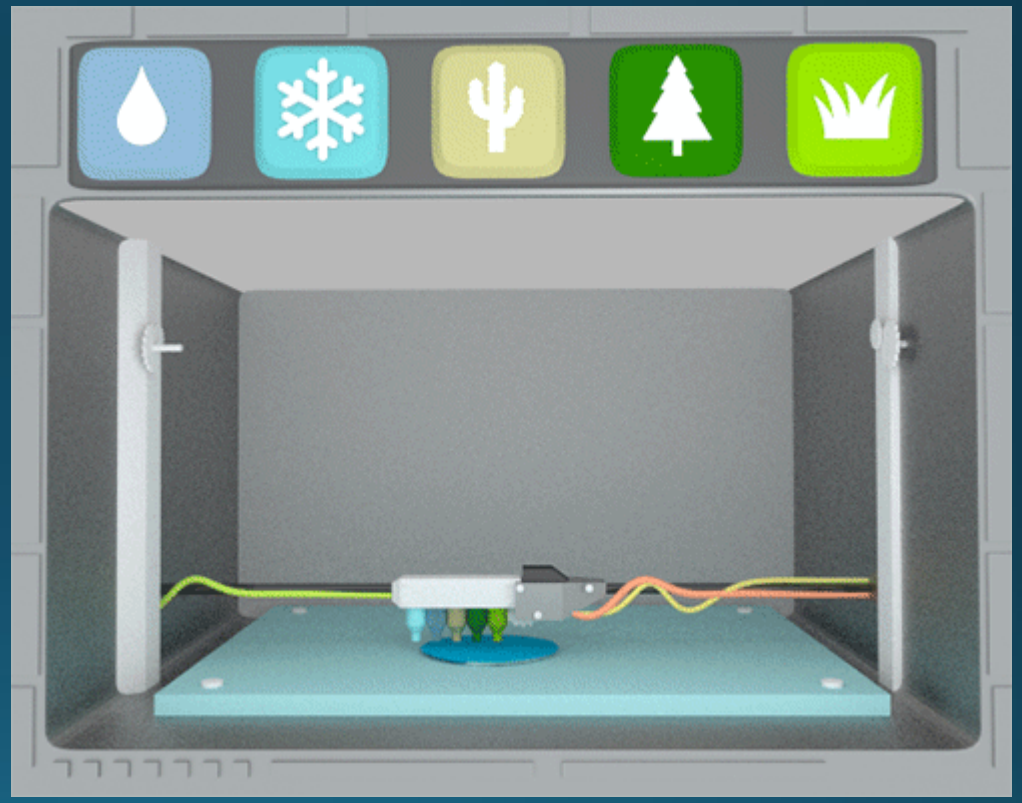


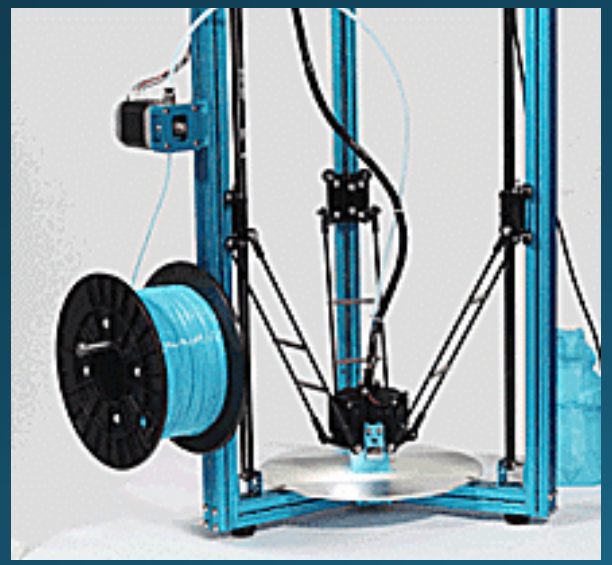
https://tinyurl.com/mitglass



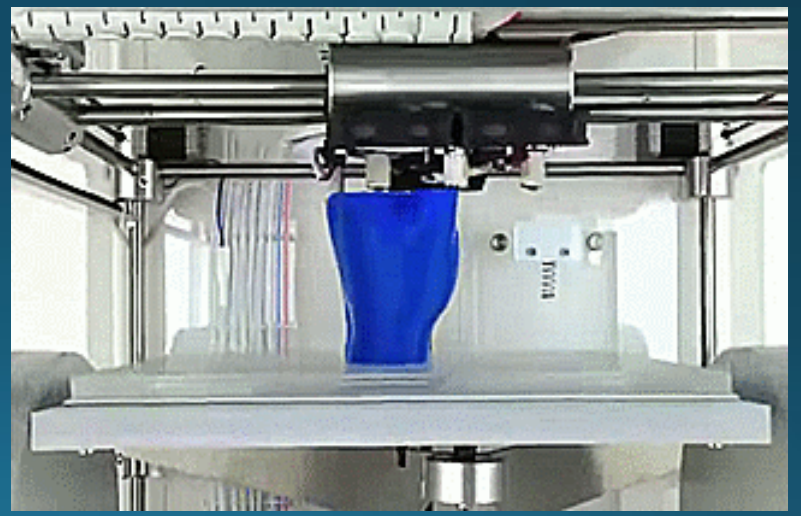
https://gifer.com/en/CAnS

Shades of FFF-style 3D Printers

- Delta-style printers (operates along the 3 vertical axes, the bed remains stationary)



- Cartesian-style printers (operates along X and Z axes, the bed moves along the Y-axis)



https://giphy.com/gifs/drawbot-TXksaSUxsB9i8

https://gfycat.com/gifs/detail/FocusedNaturalEmperorpenguin

3D Printing in the Makerspace

- Library Makerspace uses Filament (ABS/PLA/NinjaFlex)
- Filament-Based 3D printing is currently the most popular
- Why
  - Raw materials are mass-produced – higher quality, lower cost
  - Smaller-scale printers easily fit on the kitchen table
  - Many industries are utilizing this technology
  - This “hot-glue gun” style is less messy, less hazardous

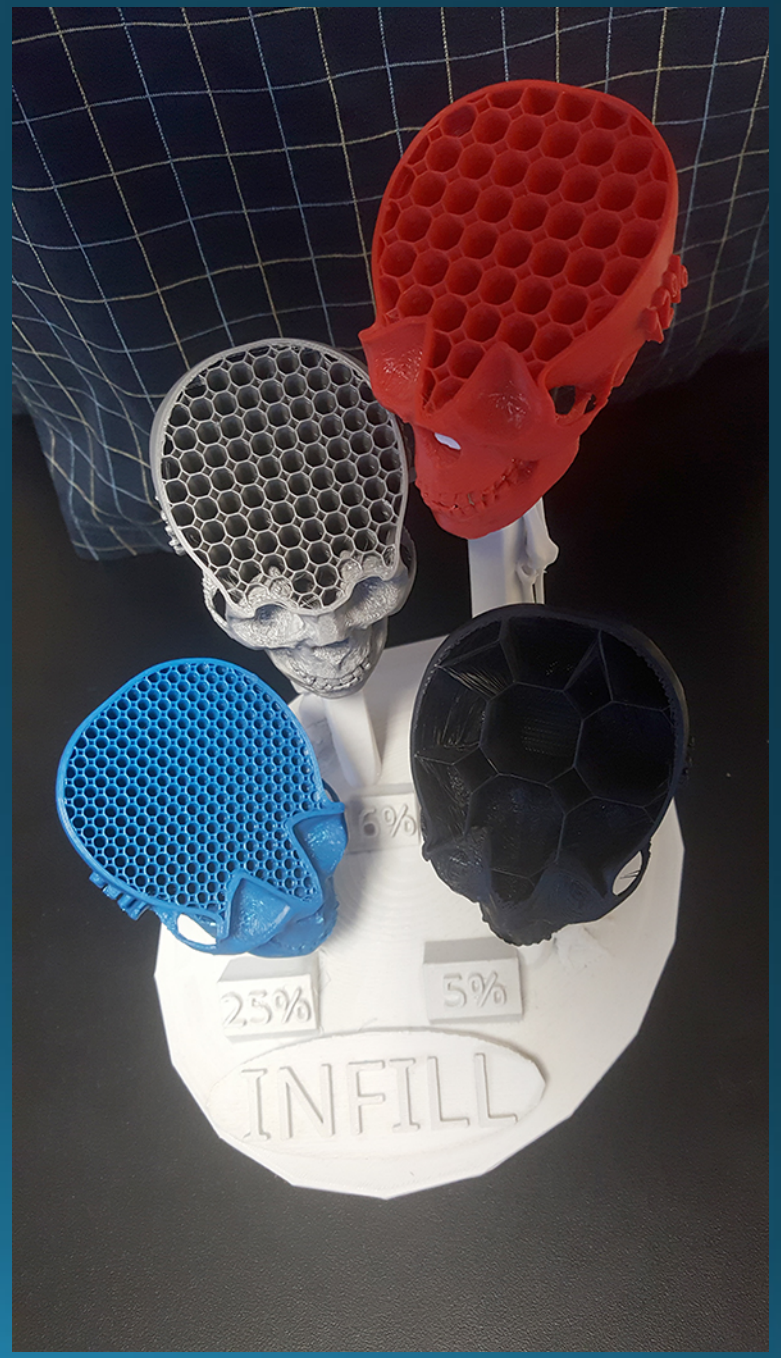
Filament-style Prints

- Filament-based printing:
  - Slice (outline/layers)
  - Crust (outside layer thickness)
  - Sponge (inside/infill)

- Properties of each element are determined by how your model will be used

Filament-style Prints 2

- Infill % indicates the internal volume of the model that will be filled with plastic
- For most purposes 5-15% is plenty of infill to support the model as it prints and as it is used
- Several infill pattern styles
  - Straight (diamond pattern)
  - Octagonal (honeycomb classic)
  - Specialized (some slicing programs offer complex 3D patterns for more multidirectional strength)



Filament-style Prints: 3

- Filament-based printing in motion – Support Material

WATCH THE TREE LIMB DROOP
AS IT GETS LONGER

BEFORE

AFTER

http://siz.io/making-3d-printing-with-a-hot-glue-gun/

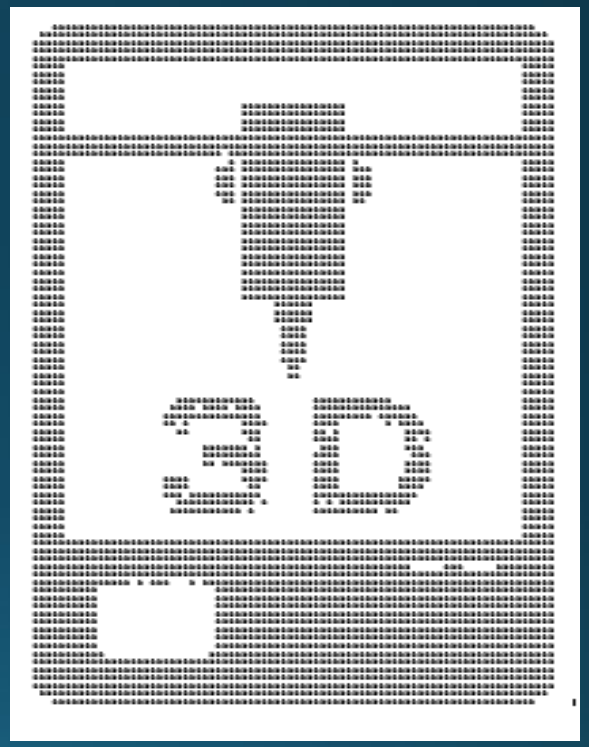
https://www.thingiverse.com/thing:4005593

3D Printing Questions

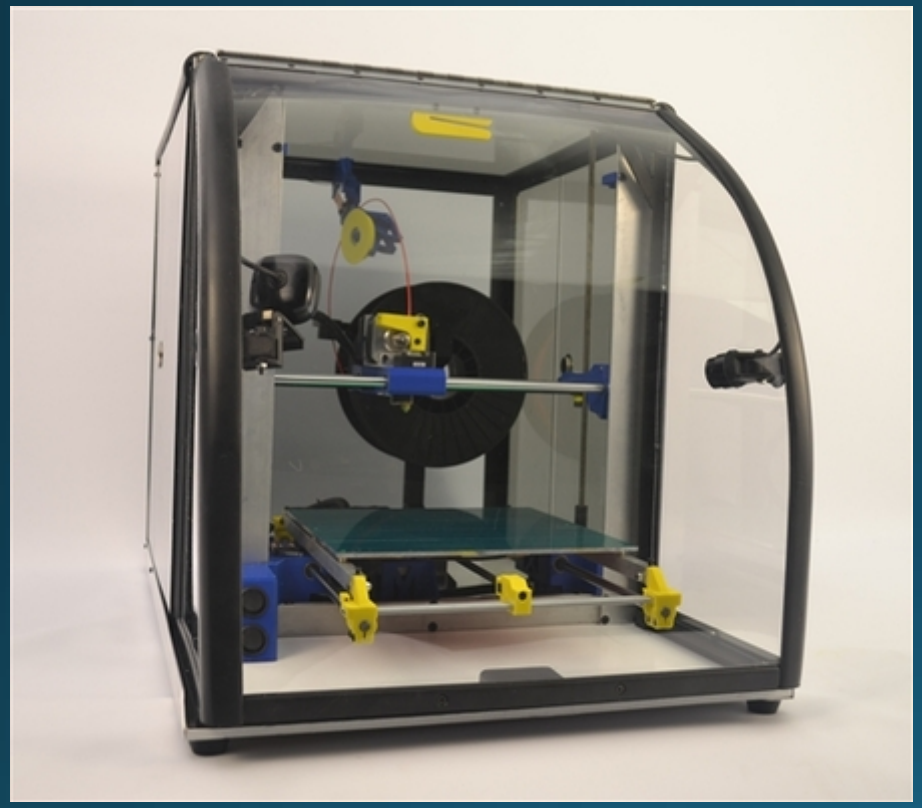
- Making a large number of something?
- Making very large objects? Bigger than the printer can handle?
- Making objects with durability or temperature requirements? Test conditions on samples of the plastic you will be printing with.
- Most printers print models using:
  - **ABS plastic** (Acrylonitrile Butadiene Styrene)

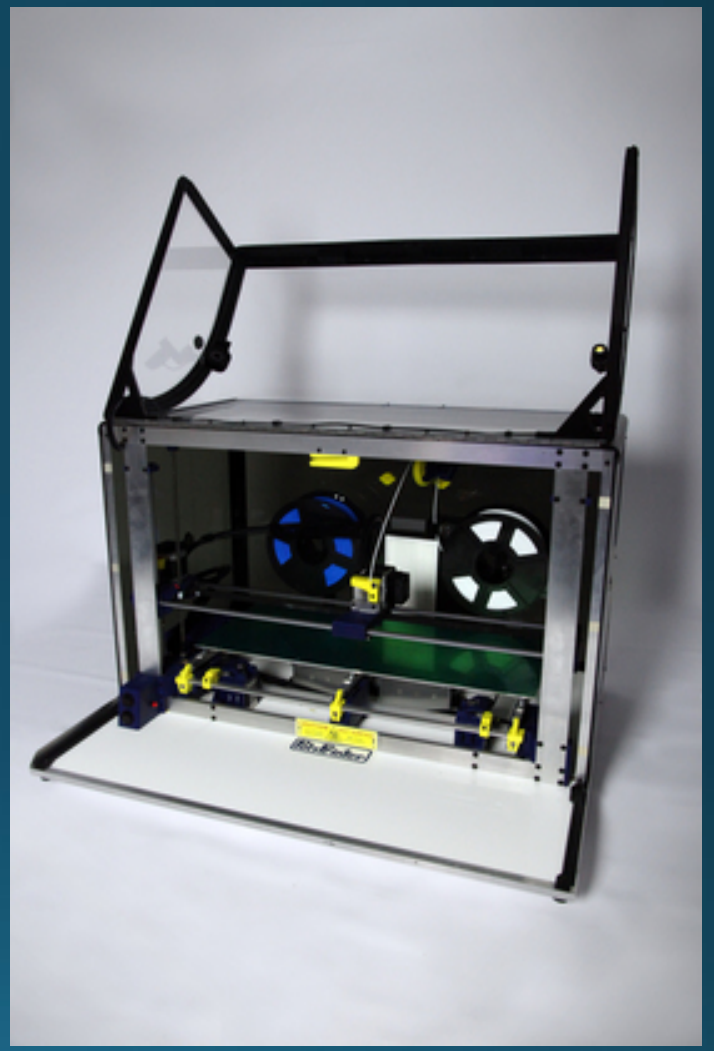
  OR
  - **PLA plastic** (PolyLactic Acid)

  Both are called "thermoplastic polymers"



Our PolyPrinters 229/508





http://www.polyprinter.com/

Specifics of Our PolyPrinters (229/508)

- Cartesian-style printers (the gantry framework operates along the X and Z axes, and the bed moves along the Y-axis)
- Printers use 1.75mm diameter filament
- Models should be less than about 8.5 inches (our printers max out at 220 x 220 x 220 mm, and 220 x 490 x 220 mm)
- Most models will be made from plastic (ABS -Acrylonitrile butadiene styrene – a thermoplastic polymer)
  - We print our ABS at nozzle temperatures of 260-270C and print bed temperature of 110C
- We can also change out the extruder head to print flexible plastic (TPU – thermoplastic urethane)
  - NinjaFlex (a brand of TPU filament) prints at 230-250C with print bed temperature of 60C

Cost to use our PolyPrinters (229/508)

- ABS plastic
  - Fee of $1.00 for each print bed/color used
  - 10 cents/gram of filament used

- NinjaFlex plastic
  - Fee of $1.00 for each print bed/color used
  - 30 cents/gram of filament used

Cost to use our Ultimaker 3

- Dual-extruder allows two-color prints or different support materials

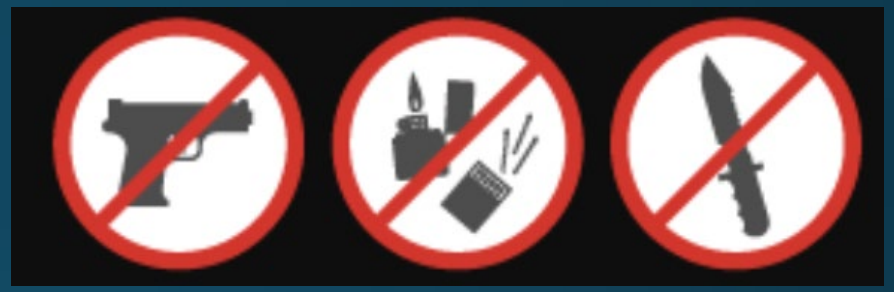
- Print volume max (smaller for dual extrusion):
  - 230 x 190 x 200 mm
  - https://ultimaker.com/3d-printers/ultimaker-s3

- PLA plastic
  - Fee of $1.00 for each print bed/color/extruder used
  - 20 cents/gram of filament used

- Breakaway PLA/Dissolvable PVA plastic
  - Fee of $1.00 for each print bed/color/extruder used
  - 30 cents/gram of filament used

What You Can Make in the Makerspace

- Anything…except:
  - NO weapons please
  - NO trademarked objects

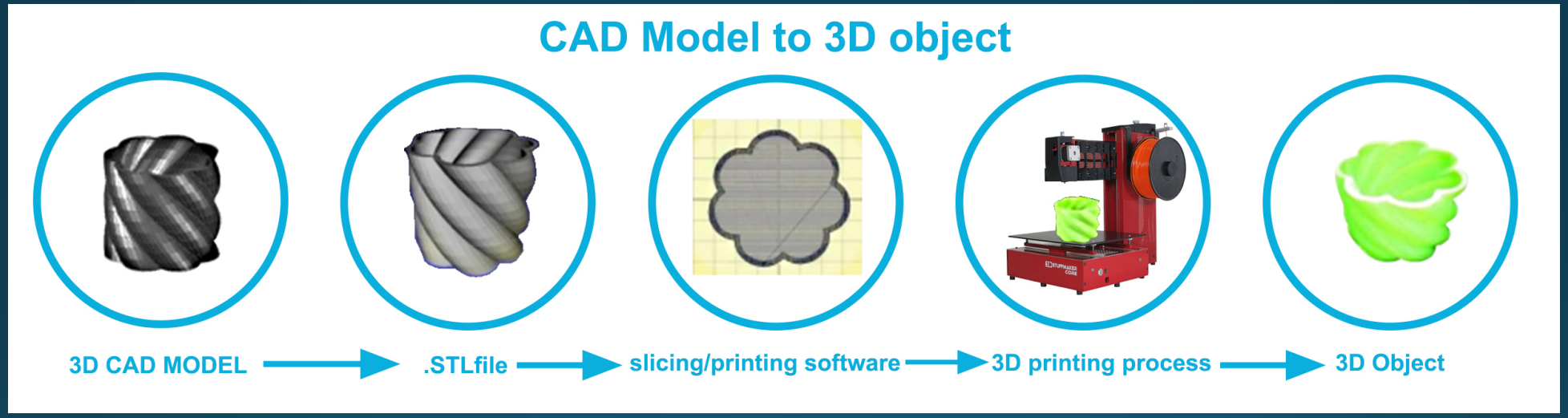


- We reserve the right to refuse objects that we suspect may violate the Student Code of Conduct

https://tinyurl.com/ttustudentcode

https://www.flyjacksonville.com/images_web/items-pro.png

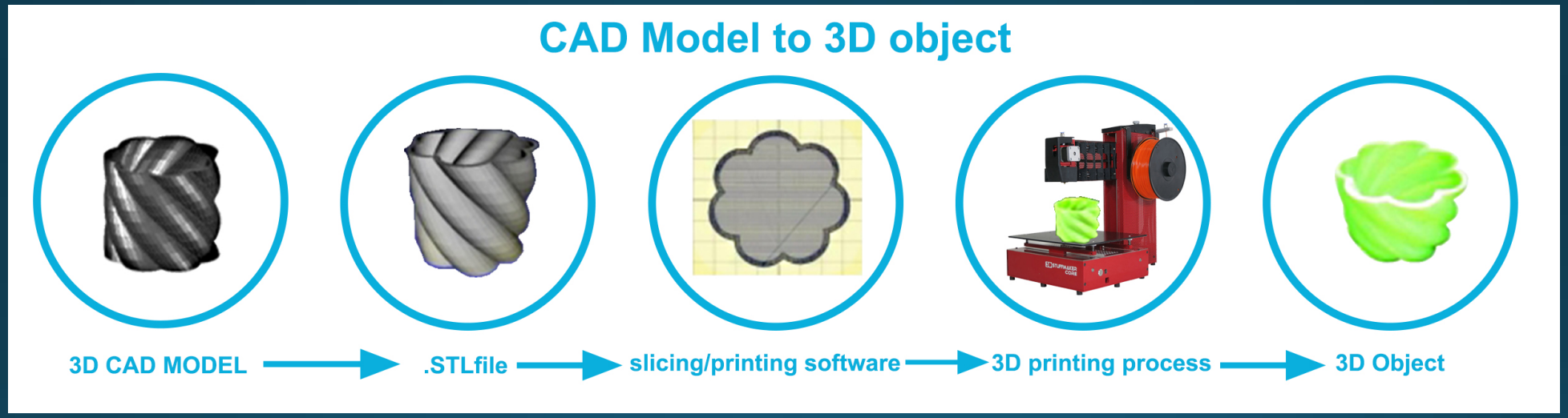
Overview



-3Dstuffmakers.com

Part 2 – Let’s do it!

Getting Started: Overview



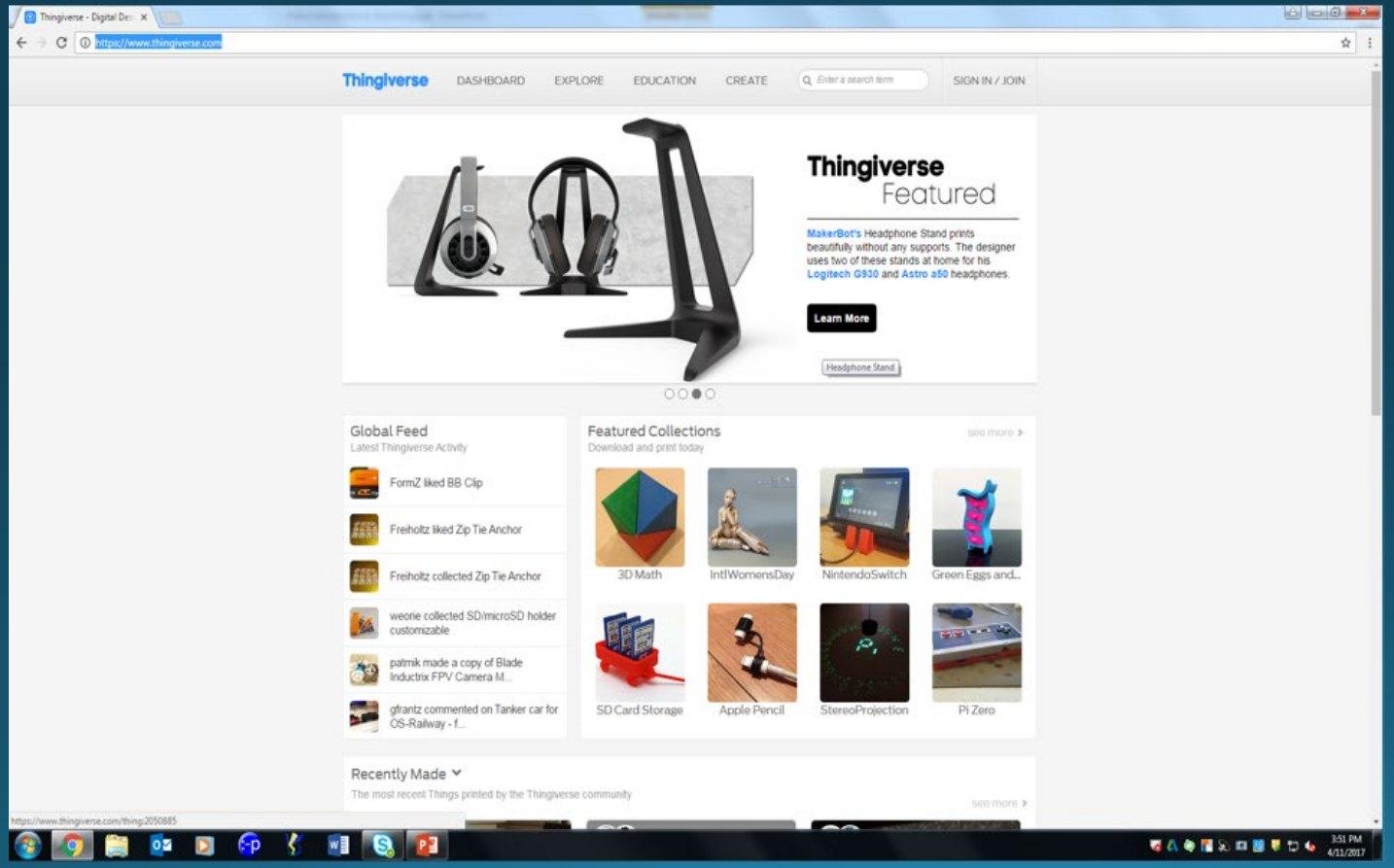
-3Dstuffmakers.com

Getting Started: File Formats

- Most common file formats you might deal with are:
  - **.STL** (**S**urface **T**essellation **L**anguage file)
    - The "PDF for 3D files" - universal file type required for 3D printing
    - Describes the outside of the model using a system of triangles (polygons) – originally named for stereolithography
  - **.OBJ**
    - A rising standard of easily editable "3D object" files
    - Used by TinkerCAD, 3D Builder and several other programs
- If you are unsure what program the CAD file was made in check this list: https://fileinfo.com/filetypes/cad

Locating a 3D Model

- Thingiverse https://www.thingiverse.com/



Other sites to find a 3D Model

- Yeggi
  - https://www.yeggi.com/
- CADForum
  - https://www.cadforum.cz/cadforum_en/
- Cults3D
  - https://cults3d.com/
- Prusa Printers
  - https://www.prusaprinters.org/prints
- MyMiniFactory – (not free)
  - https://www.myminifactory.com/

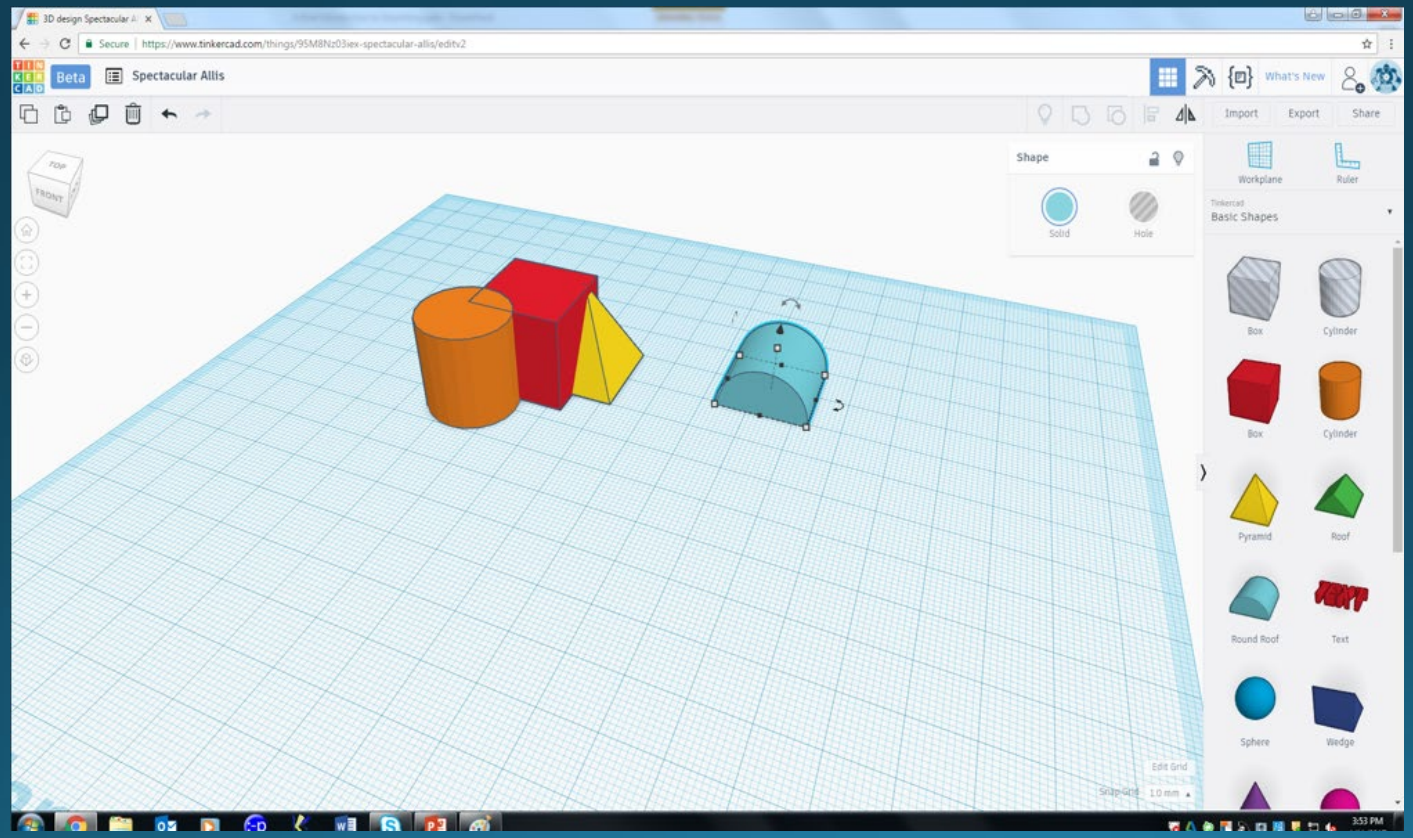
Getting Started: TinkerCAD

- Recommended hardware
  - Internet connection
  - Chrome/Firefox browser
  - Two-button mouse with a scroll that can click (3-button mouse)

- Create a free account with a valid email
  - www.tinkercad.com
  - Can use an existing Autodesk account
  - Must be of legal age 13+ or account must be created by a guardian/adult
  - Teachers can create an account for their class and provide students with a code

Designing a 3D Model

- TinkerCAD
  https://www.tinkercad.com



Getting Started 2: TinkerCAD

- Modify Files
  - Files under 7MB
  - STL, OBJ, SVG file types
  - Chop/change them up, add your name

- Original designs
  - Simple and scaled designs for 3D printing
  - Import/convert SVG files into 3D objects
  - Shared files or play with “shape generators”

Part 3 – Onward and Upward!

Other programs to explore

- Free
  - 3D Builder – Win10 app
  - Fusion 360 – Hobbyist license through Autodesk
  - Meshmixer
  - Sculptris
  - Blender – freeware
- Free for students
  - Autodesk Suite (Inventor, NetFabb, AutoCAD, etc.)
- Available on campus (not usually free)
  - Rhinoceros 3D (Library, Architecture, Landscape Architecture, free trial)
  - Z-Brush (Library 2nd floor 3D Animation Lab)
  - Solidworks (Library 2nd floor 3D Animation Lab)

Onward: Assistance Is Available

- The Staff and Student Assistants in the Makerspace are here to help you locate or design an object: make@ttu.edu
- There are O'Reilly video and text tutorials available to help learn the more advanced design software (Solidworks, Rhino, Autodesk Suite, etc.) through Library Databases:
  - Search for "safari" or "oreilly" @ http://texastech-ml.hosted.exlibrisgroup.com/V/?func=find-db-1
- Adafruit Discord is highly recommended – https://adafru.it/discord
- Open-Source Wikiversity on 3D printing and designing (free software and hardware) https://en.wikiversity.org/wiki/Open_Source_3-D_Printing
- Youtube, Hackaday.com, many 3D forums, and most companies offer a wide variety of tutorial assistance

Onward: Videos for review

- What is 3D printing
  - https://www.youtube.com/watch?v=Llgko_GpXbI
  - https://www.youtube.com/watch?v=VxoZ6LplaMU
- How does Resin 3D Printing Work
  - https://www.youtube.com/watch?v=yW4EbCWaJHE
- How does powder-based 3D Printing work
  - Gypsum - https://www.youtube.com/watch?v=kBHsfNDsbCs
  - Metal - https://www.youtube.com/watch?v=te9OaSZokf8

Onward: 3D printing near me

- On TTU Campus
  - TTU Library Makerspace – make@ttu.edu, Library 132, https://www.depts.ttu.edu/library/make/index.php
  - ATLC - Library basement, https://www.depts.ttu.edu/itts/services/3dprint/faqs.php
  - Architecture - https://www.depts.ttu.edu/architecture/
  - 3D Art Annex - http://www.depts.ttu.edu/art/Programs/graduate/studio_art/sculpture/index.php
  - Mechanical/Civil Engineering & IMSE
  - Ask your department – there are 3D printers hidden all over campus

- Off-Campus
  - ULABS (Ubiquitous Makerspace) - http://www.ulabstx.org/
  - Science Spectrum - https://www.sciencespectrum.org/fab-lab/
  - UPS - https://www.theupsstore.com/print/3d-printing

- Online
  - Shapeways - https://www.shapeways.com/
  - iMaterialise - https://i.materialise.com/en
  - MyMiniFactory - https://www.myminifactory.com/

Option 2: Be the 3D Printer

- 3Doodler Pens and Create Pens put the plastic extruder at your fingertips
- Ask us about checking them out

http://the3doodler.com/

Thank you!

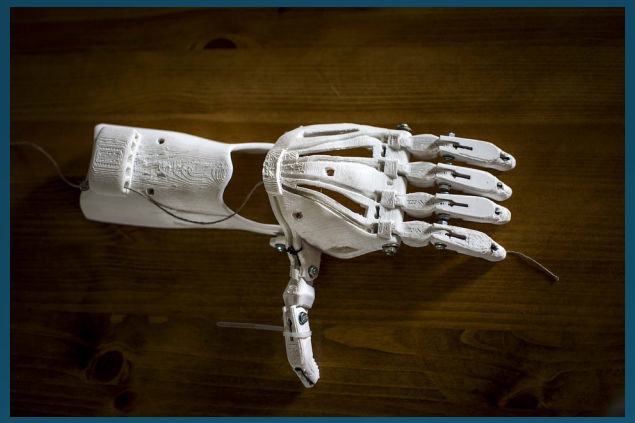
Welcome to the World of 3D design!

Workshop Evaluation Form

tinyurl.com/Tinkering101Form

Let's make the future together!

Please share with us your journey into the 3rd dimension!



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Staff Member - sean.scully@ttu.edu

http://3dprintingpress.blogspot.com/ http://enablingthefuture.org/ https://tinyurl.com/3dcheezprinter

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